



VULNERABILITY OF LIVELIHOODS TO CLIMATE CHANGE IN SELECTED COMMUNITIES OF THE KUBANNI BASIN, KADUNA STATE, NIGERIA

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ABSTRACT

Climate change refers to significant, long-term changes in the patterns of temperature, and other elements of the Earth's climate system. These changes occur naturally or as a result of human-induced alterations caused by activities such as the burning of fossil fuels, deforestation, industrial processes, and agriculture. The result of this change can lead to unfavourable impacts hence this study seeks to investigate the vulnerability and adaptation of six communities in the Kubanni basin to environmental challenges by obtaining information on gaps in the management of climate change, food and livelihood insecurity, as well as government responses to climate change through focus group discussions and key informant interviews with government officials, community leaders, and leaders of the various groups. The study found that livelihoods groups most impacted were farmers, livestock rearers, processors of agricultural produce, fishermen, craftsmen, and hunters. In order to ameliorate the adverse conditions, communities employed hand-dug wells for domestic water and irrigation, increased use of inorganic fertilizers, animal traction, and integration of food crop farming with pastoralism. Limited assistance was provided by governmental and multilateral agencies. Several key issues in managing climate change in the area were identified, such as inadequate policy frameworks and a significant lack of funding, among others. The study concluded that there were few or no incentives for the local population to reduce activities that contribute to climate change, thereby making community engagement difficult and the public less likely to participate in mitigation efforts. This study recommends the institutionalisation of decentralised community-inclusive climate frameworks supported by localised funding, alongside the deployment of economic incentives to actively foster public participation in sustainable mitigation efforts.

Keywords: Adaptation, Climate, Environmental, Livelihood, Kubanni, Vulnerability

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INTRODUCTION

Climate change is one of the greatest dangers to sustainable development, as climate hazards are progressively affecting human societies and ecosystems. Climate change is increasingly acknowledged as a major threat to ecosystems' ability to provide services that promote human well-being [1]. Human well-being and sustainable development depend on improved ecosystem management to ensure conservation and sustainable use. However, growing demands for services such as food and water are diminishing ecosystems' capacity to meet them. Climate change disproportionately threatens human and natural systems due to varying vulnerabilities. [2] defines vulnerability as the propensity to be adversely affected, driven by historical, social, environmental, political, and economic factors [3]. Climate change exacerbates environmental stressors, and its impacts vary significantly based on individuals' and societies' adaptive capacities [4]. Marginalised groups,

including the economically, socially, and politically disadvantaged, are particularly vulnerable [5].

Ecosystems, also exposed to natural and human-induced hazards, face high risks with a warming of 2°C [2]. Climate change affects forests' ability to provide essential services, leading to decreased productivity, tree die-back, increased erosion, forest fires, and pest outbreaks (FAO, 2015). Biodiversity, including species distribution and ecosystem function, is impacted by extreme weather events, fires, and floods [6]. Some ecosystems may adapt or migrate, while others may collapse or face extinction [7]. Climate change limits development options and increases pressures on terrestrial, freshwater, and marine habitats [8], with soil erosion and salinisation further affecting rural and coastal livelihoods [9].

The rural and urban poor within the Kubanni basin particularly highly dependent demographics like young and elderly populations possess limited adaptive capacity, rendering their livelihoods highly vulnerable to climate change. As strategic planning

shifts toward medium- and long-term horizons, evaluating past climate disruptions is essential. Developing adaptation strategies that safeguard both these localised livelihood groups and their fragile ecosystems is critical to securing sustainable development pathways in Kaduna State.

Conceptual framework

The Millennium Ecosystem Assessment (MEA) [10] posits that humans are integral parts of ecosystems, and that a dynamic interaction exists between them. This interaction, driven by the changing human condition, directly and indirectly influences ecosystems, which in turn impact human well-being. While the MEA emphasises the linkages between ecosystems and human well-being, it recognizes that human actions influencing ecosystems are not solely driven by concerns for human well-being but also by considerations of the intrinsic value of species and ecosystems. Intrinsic value refers to the value of something in and for itself, irrespective of its utility for someone else. The MEA synthesises information from the scientific literature, relevant peer-reviewed datasets, models, and incorporates knowledge held by the private sector, practitioners, local communities, and indigenous peoples [9].

Community-based adaptation (CBA) to climate change is an approach that aims to include vulnerable people in the design and implementation of adaptation

measures. CBA can encompass simple, accessible technologies such as storing freshwater during flooding or raising the level of houses near the sea. It can also involve more complex forms of social and economic resilience, such as increasing access to a wider range of livelihoods or reducing the vulnerability of social groups particularly exposed to climate risks.

Ecosystem-based adaptation (EbA), as defined by the Convention on Biological Diversity (CBD), utilizes biodiversity and ecosystem services to help people adapt to the adverse effects of climate change. EbA embraces "the integrated management of land, water and living resources that equitably promotes conservation and sustainable use" within the context of supporting communities in coping with climate change impacts. It employs familiar tools and measures but conceptualises and implements them specifically for adaptation to climate change.

However, Community-based Adaptation (CBA) and Ecosystem-based Adaptation (EbA) are two distinct approaches to adaptation that have gained popularity in recent years. Each has a distinct focus: CBA emphasises local community empowerment to reduce vulnerabilities, while EbA emphasizes ecosystem management as a means of providing commodities and services in the face of climate change [9].

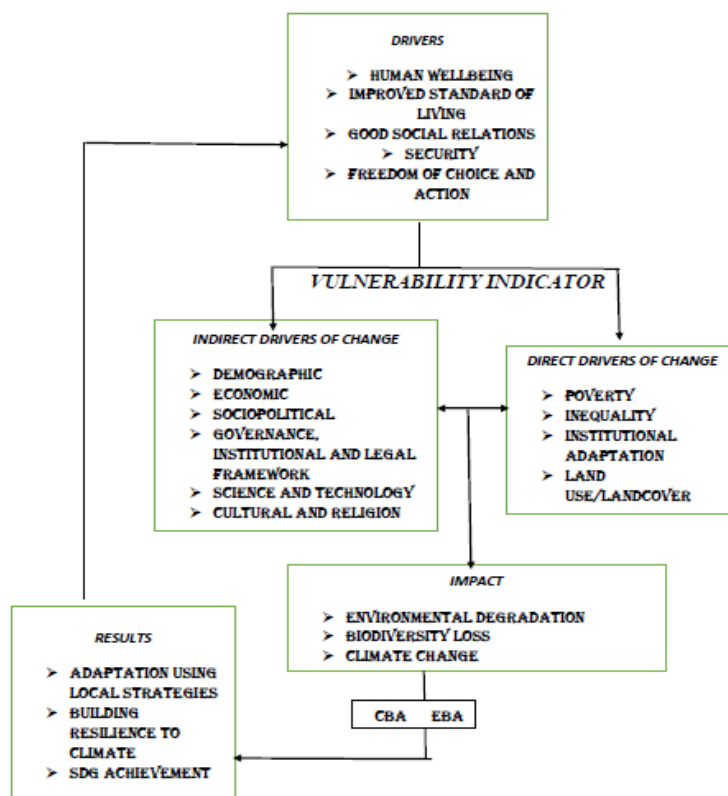


Figure 1: Linkages between the components of human well-being

Source: Authors

Figure 1 depicts the strength of linkages between the components of human well-being that are commonly encountered, environmental factors as well as economic, social, technological, and cultural factors which influence human well-being, and ecosystems which are in turn affected by changes in human well-being. Changes in drivers that indirectly affect the ecosystem, such as population, technology, and lifestyle can lead to changes in drivers directly affecting the ecosystem. These result in changes to ecosystems and the services they provide thereby affecting human well-being.

In the Kubanni basin, climate risks can cause shocks to agricultural production and food availability, including market disruptions, effects on supply and storage systems, and increases in agricultural commodity prices (food and feed), affecting the accessibility and stability of food supplies for the entire population, especially in countries where a large proportion of the population spends a significant portion of their income on food [5]. Climate change has the potential to stymie agricultural development by deterring investment. Figure 1 also shows the impacts of climate change on food security and nutrition. Climate change has a variety of social and economic impacts, including changes in agricultural earnings, food markets, prices and trade patterns, and investment patterns [5].

These impacts have the potential to reduce agriculture income, influence physical capital and

have the power to compel farmers to sell productive capital, such as livestock, in order to absorb revenue shocks. They also have the potential to impair investment capacity and this has obvious societal consequences for agricultural households, restricting their ability to cover other costs such as health and education. Vulnerable populations are already being driven further back into poverty and instability, and this trend is expected to continue, reversing decades of progress [9]. There is no one-size-fits-all solution to adaptation.

This study focuses on investigating the vulnerabilities and climate resilience of Kubanni communities and ecosystems to climate change. The poorest people and communities on the planet particularly those in the Kubanni basin are the most susceptible to climate change; they are on the front lines of a changing climate, with everything to lose and little to cushion the effects [9]. Climate change is having and will continue to have impacts on vulnerable people's livelihood assets and rights, particularly those who rely on biodiversity and ecosystem services for food, water, and shelter, and especially in times of need or to fulfil contingencies. Climate change is probably one of humanity's most pressing concerns, with global temperatures expected to rise by more than 1.5 degrees Celsius beyond pre-industrial levels by 2100 [2].

Despite the numerous studies on climate change, general understanding of the hazards of

climate change and biodiversity loss, and the need to safeguard ecosystems and important natural resources, the Kubanni basin remains understudied. The vulnerability assessment of the basin stems from the critical need to build climate resilient communities, particularly for vulnerable people, as well as to protect the environment and mitigate the impacts of climate change. Even though some studies exist on building climate-resilient communities and ecosystems, not many of such have dealt specifically on the study area, the Kubanni basin. Existing research efforts are disjointed and insufficient to establish a baseline for assessment or support policy formulation. In view of dearth of information from the study area, this study was carried out to fill the identified gap.

The objectives of this study focus on major environmental challenges as a result of climate change in the study area; on how people adapt in the face of increasing strain on ecological services and livelihoods; the vulnerabilities of agriculture and the population to climate change impacts. government responses to climate change in the basin; and the gaps identified in the management of climate change within the basin.

MATERIALS AND METHODS

Study area and site

The study area (Kubanni basin) consists of River Kubanni which has its source from the Kampagi hill,

in Shika near Zaria. It flows in southeast direction through A.B.U., Zaria. It has four tributaries [11]. The economic activities in the study area reflect the commercial, services, administrative, industrial, transport and professional needs of the state and northern Nigeria. The study area has a rapid and dynamic physical, economic and social transformation of the town [12]. The basin (Figure 2) is about 15 kilometres (km) long and 7 kilometres wide, with a total area of about 105 km² and it is approximately bounded by latitudes 11° 4' 25" N and 11° 10' 46" N and longitudes 7° 36' 55"E and 7° 44' 12"E [13]. The Kubanni river flows through a number of research institutions, including Ahmadu Bello University Teaching Hospital (ABUTH), College of Agriculture Samaru, Centre for Energy Research and Technology (CERT), and Nigeria College of Aviation Technology. The river also passes through several rural and urban settlements, including Samaru, Kampagi, Tudun Wada, Wusasa, Kufenna, Zango, Palladan, Kwangila, Tudun-Jukun etc. In a NW-SE orientation, the basin is extended and it is widest near Ahmadu Bello University's Institute of Agricultural Research in Zaria and smallest where it enters the Galma River [14]. The vegetation Land-Use–Land-Cover (LULC) recorded a decrease in land area, in the 32-year period under review, while the waterbody, built-up and uncultivated land LULC classes exhibited increases; with average annual rates of change of –1.23 % (vegetation), 0.44 % (uncultivated land), 3.77 % (built-up) and 4.66 % (waterbody), respectively [15].

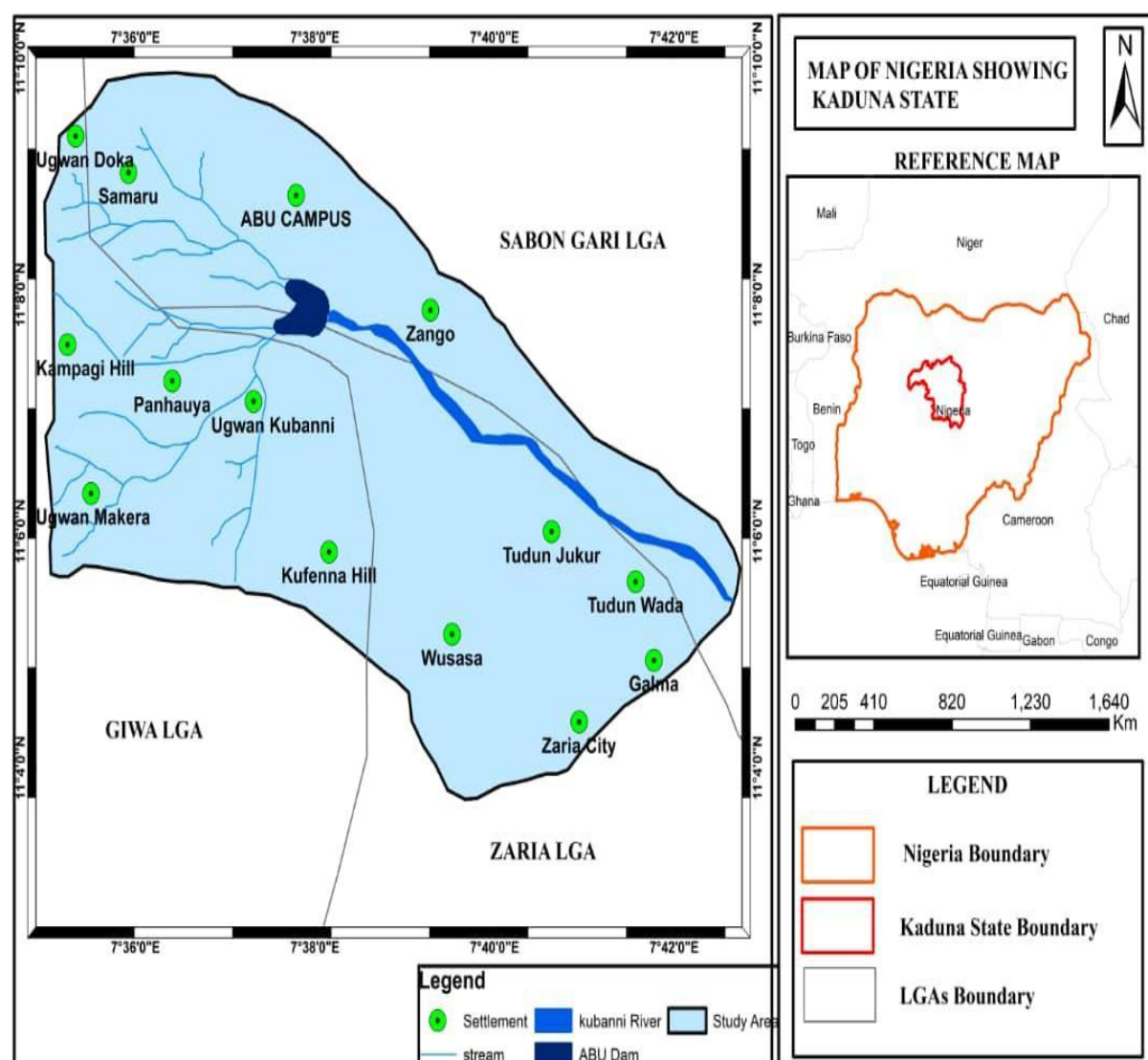


Figure 2: The Study Area (Kubanni Basin)
Source: Field data, 2022

Data on the major environmental challenges facing the Kubanni communities; adaptation of the people to climate change; vulnerability assessment of agriculture to climate change; and vulnerability of population to food and livelihood insecurity were obtained through interviews with key informants such as local government officials in charge of agriculture, environment and water resources; focused group discussion with the leaders of the various livelihood groups in the basin; and personal observation of the researchers. Global Positioning System (GPS) was used to get the coordinates of six sampled settlements within the basin in order to map the settlements. The data sets obtained were analyzed and presented using descriptive statistics. The basin was stratified into western, central and northern zones and two settlements were randomly selected from each zone. The settlements so selected are Samaru and Kampagi (western zone); Tudun Wada and Wusasa (central zone); and Kufenna and Zango (northern zone).

RESULTS AND DISCUSSION

Livelihood

The livelihoods of the people of the study area as discovered through the interviews with the community leaders is as shown in Table 1.

Table 1: Livelihood of the inhabitants of Kubanni Basin

S/no	LIVELIHOOD
1	Livestock Rearing
2	Fishing
3	Hunting
4	Civil service
5	Trading/marketing
6	Processing of Agricultural Produce
7	Hired labor

8	Crafts
9	Cart-pushing
10	Butchering
11	Farming

Source: Authors' Fieldwork, 2022

From Table 1, the livelihoods of the people of Kubanni basin were livestock rearing, fishing, hunting, civil service, trading/marketing, processing of agricultural produce, hired labor, crafts, cart-pushing, butchering and farming. This was discovered on the basis of the questionnaire administered to the people of the Kubanni basin.

Major environmental challenges in the study area

From the various data collection means, the major environmental challenges in the study area is as presented in Table 2 which are deforestation, soil erosion, drying up of streams/rivers/wells, flooding, pests and diseases, drought (inadequate rainfall), late onset of rainfall, prolonged dry spells, shortage of water, increasing temperature and outbreak of diseases.

Table 2: Major environmental challenges in the study area

S/N	Environmental challenges
1	Deforestation
2	Soil erosion
3	Drying up of streams/rivers/wells
4	Flooding
5	Pests and diseases
6	Drought (inadequate rainfall)
7	Late onset of rainfall
8	Prolonged dry spells
9	Shortage of water
10	Increasing temperature

Source: Authors' Fieldwork, 2022

Community adaptation to climate change

The adaptive capacity to climate change of the people of the basin is shown in Table 3 and they are access to water for irrigation by digging wells, increase use of farm inputs, increased use of organic and inorganic fertiliser, purchase of grasses for animals, use of animals for traction, involvement in many livelihoods, integration of more food crop farming with pastoralism are the major adaptation strategies to climate change adopted.

Table 3: Community Adaptation to Climate Change

S/n	Adaptation
1	Access to water for irrigation by digging wells
2	Increase use of farm inputs
3	Increase use of organic and inorganic fertiliser
4	Purchase of grasses for animals
5	Use of animal for traction
6	Involvement in many livelihoods
7	Integration of more food crop farming with pastoralism

Source: Authors' Fieldwork, 2022

Vulnerability assessment of agriculture to climate change

The response of the inhabitants captured through the questionnaire to the vulnerability assessment of agriculture using the main crops grown in the study area to climate change, the observed barriers that made them vulnerable, and the scale of relevance of these crops to the inhabitants of the study area is presented in Table 4.

Table 4: Vulnerability Assessment of Agriculture to Climate Change

S/n	Crop	Barrier	Relevance	Land use	Primary Occupation of participant
1	Millet	Rainfall shortage and lack of agricultural inputs	1	Agriculture	Farmer
2	Rice	Rainfall shortage and lack of agricultural inputs	7	Agriculture	Farmer
3	Beans	Rainfall shortage and lack of agricultural inputs	8	Agriculture	Farmer
4	Groundnut	Rainfall shortage and lack of agricultural inputs	5	Agriculture	Farmer
5	Guinea Corn	Rainfall shortage and lack of agricultural inputs	2	Agriculture	Farmer
6	Sesame	Rainfall shortage and lack of agricultural inputs	6	Agriculture	Farmer
7	Water Melon	Rainfall shortage and lack of agricultural inputs	9	Agriculture	Farmer
8	Livestock	Rainfall shortage and hot temperature and veterinary centers	4	Agriculture	Herders
9	Cowpea	Rainfall shortage and lack of agricultural inputs	3	Agriculture	Farmer

Source: Authors' Fieldwork, 2022

Vulnerability of populations to food and livelihood insecurity

An empirical assessment of the Kubanni basin communities reveals a stark dichotomy between localised socio-economic stability and acute institutional vulnerability. Focus Group Discussions (FGDs) indicate a robust baseline for food security and water availability. This resilience is fundamentally driven by a widespread dual-production system, where households simultaneously engage in crop cultivation and livestock rearing. Anticipated household harvests effectively satisfy local dietary demands, maintaining food stability through functional market exchanges of surplus produce. Furthermore, environmental vulnerability regarding water security is actively mitigated by high community access to functional and localised boreholes.

Conversely, this baseline stability is severely undermined by a complete absence of public healthcare infrastructure. Lacking primary health centers, residents face a critical governance gap, forcing them to either travel extensive distances to the Ahmadu Bello University Teaching Hospital (ABUTH) in Shika or incur prohibitive out-of-pocket expenses at private clinics.

To mitigate these institutional failures, the population deploys autonomous, reactive adaptation strategies. In the health sector, communities rely heavily on local Patent and Proprietary Medicine Vendors (PPMVs) and traditional herbal practitioners. While this provides low-cost proximity care, it functions as a high-risk defensive adaptation born out

of structural neglect. Concurrently, to safeguard agricultural livelihoods against climate shocks, households practice adaptive food by smoothing storing and rationing grain reserves in traditional silos to bridge the lean season. Highly adaptive households further diversify their income portfolios by maintaining up to four distinct livelihood streams, including agro-processing, craftsmanship, and petty trading.

Ultimately, these findings expose a structural paradox: autonomous adaptation currently serves as a primitive substitute for absent governance. Lacking formal technical training, extension services, and financial capital, these local coping practices are reaching their absolute threshold. Transitioning these communities toward sustainable development pathways requires urgent, targeted institutional interventions, specifically decentralised infrastructure and subsidised, climate-smart agricultural inputs.

Government responses to climate change

From the key informant interview with the local government officials and the focus group discussions with the various livelihoods' groups and community leaders, it was gathered that:

- i. Inter-linkages with other Sectors – water, energy, health, poverty This has been very poor except for water sector that had set up several boreholes in the communities to provide water for domestic consumption.
- ii. Programs by the governments to build climate resilience in the agriculture sector in

order to reduce the adverse-effects of desert encroachment and its attendant consequences, the state government raised and distributed millions of assorted seedlings to arrest desert encroachment and boost agriculture. The state government also directed that trees should be preserved and banned tree-felling for charcoal harvesting. The government also facilitated the identification and provision of fertilisers and inputs to farmers and to control aquatic weeds invasion on river Kubanni and enhance free flow of water along the course of river Kubanni.

- iii. Some mitigation measures taken by the government with regard to river and channel blockages have resulted among others in, increased river water flow downstream, reduced flooding, resulting in surfacing of farmlands and grazing areas, increased water availability to downstream communities resulting to over 60% improvement of the livelihoods of the affected communities and reduction in conflict over natural resources utilisation as more land is made available for farming, fishing and grazing. The government ensured emergency response to the problem of flash flooding in some major areas as a result of overbank flow along the course of River Kubanni which cuts across the LGA. The government also mobilized resources towards de-silting of drainages, pumping out excess water from flooded communities and the establishment of flood control structures along the most vulnerable portions of the river bank.

It was also deduced from the focus group discussions that the various government programmes have been very helpful but more interventions still need to be done to impact the vulnerable poor in the communities.

Gaps identified in the management of climate change in the study area.

It was identified during the key informant interview with the local government official and also during the focus group discussions that there existed the following gaps in the ecosystem-based management of climate change in the Kubanni basin. These gaps are:

- Policy/institutional framework

The policy framework was deficient and more of political paper work and not to really tackle the issues of climate change

- Finance and Investment Gap Analysis (Spatial, Thematic, Financial)

No finance had been allocated for the activities of climate change in the local government especially in the basin. However, information gathered from the Key informant stated that a substantial amount of money was earmarked at the Ministry of Environment for climate change though not enough to really be of high impact.

- Incentives and Innovation

There had been little or no incentives for the people to stop activities responsible or that can exacerbate the activities of climate change

- Climate Change Information provision and dissemination

There has been poor information dissemination. Most people were not even aware of climate change though they are aware of changes in temperature, rainfall and other stressors.

- Partnerships

The key interview informant said ADP, USAID, IFAD and FADAMA have been the sole partners in tackling the menace of climate change.

CONCLUSION

On the basis of the findings of this study, it is certain that the basin was being ravaged by a lot of environmental challenges as a result of the impacts of climate change with grave consequences on agriculture and food security; the various livelihoods in the study area and the entire population in the basin. The adaptive capacity of the people is low and of crude methodology not good enough to stem the great consequences being experienced by the people. The various responses of the different governments to the impact of climate change were few, not coordinated and of little effect. The gaps identified in the management of climate change in the study area can be effectively and efficiently tackled by the concerned stakeholders to help the basin especially in stemming the high poverty rate in the basin. There is also a need for the introduction of biomass to avoid deforestation by improving new technology such as wooden stoves to combat desertification by the governments and the various partners. The government should help in the reduction of post-harvest losses for agricultural produce and increase the profitability of agricultural production to help in combating some of the effects of the climate change and lastly there is a need for development plans by government and the various partners that can carefully be designed to take into account not only the adverse effects of climate change,

but also the effects of the developmental (or growth) process on the environment, people as well as resources which should be formulated and implemented.

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